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BIOLOGICAL ATTRIBUTES OF LAPPET MOTH, *TRABALA VISHNOU* LEFEBVRE (LASIOCAMPIDAE: LEPIDOPTERA) ON CASTOR

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ABSTRACT

The present work deals with the biology of *Trabala vishnou* on castor leaves. The experiment was setup for five to six month with temperature variation of 29 ± 2ºC, relative humidity ranging from 65% to 80%. The data were recorded for two generation. Ratio of light and dark period was provided for 16:8 hours respectively. Minimum incubation period was recorded (6.58±0.85) for I instar larva from second generation and the maximum duration was recorded (8.85±0.88) for IIIrd Instar also from second generation. There were six larval duration was recorded followed by pupal and adult stage.

KEYWORDS: Biology, *Trabala*, Castor, larva.

INTRODUCTION

Castor (*Ricinus communis)* belongs to the family Euphorbiaceae and have a wide application apart from its use in medicine. The plant is attacked by a number notorious pests, among them, castor semilooper (*Achaea janata* L.), castor capsule borer (*Dichocrosis punctiferalis* Guene) are the major pests causing qualitative as well as quantitative losses (Singh 1987). However, among the insect recently reaching the level of major pest from minor ones are castor butterfly (*Ergolis merione* Cramer) and lappet moth (*Trabala vishnou*). The later one is comparatively bigger in size and voracious feeder of castor leaves. The *T. vishonou* belongs to family Lasiocampidae of order Lepidoptera and the members of this family are commonly called as lappet moth and tent caterpillars (Tewari and Namgail 1999). These moths are stout-bodied, with the body, legs and eyes hairy; antennae are somewhat feathery in both sexes; females are comparatively bigger in size than males. Male moths are green in colour while female moth shows yellowish pattern. The Lasiocampid moths are widely distributed in the

oriental realm, including India, Sri Lanka, Myanmar, Malaysia, Thiland, Indonesia, China and Taiwan but not recorded from New Zealand till yet. Studies on the biological attributes, reveal the important information about the life cycle, and better pest management strategy.

MATERIALS AND METHODS

Experimental site

Present investigation was conducted at Department of Zoology, Aligarh Muslim University, Aligarh under laboratory condition. The temperature was maintained 29± 2˚C with relative humidity ranging from 65 to 80%. The ratio of light and dark hours was delimited 16L:8D hours.

Stock Culture

The fresh pupae were collected from infested fields at Punjipur village of Aligarh district and brought to laboratory for further studies. Pupae were paired on the basis of their size and kept in glass jars (24:14 cm length and diameter). After emergence of adults, 15% sugar solution in the form of food was provided with an arrangement of flower pots (rose and grass flowers) as well as with cotton swabs. Additionally, the food was provided on the internal walls of glass jar in the form of fine droplets with the help of camel hair brush (No.0). Finally, feeding followed by successful mating resulted in egg laying on rearing material *viz*., muslin cloth and walls of glass jar.

Egg laying on muslin cloth was isolated by cutting the laid area facilitating no disturbance to the eggs laid on it. However the eggs laid on walls of the jar were kept untouched with fresh food in the form of castor leaf was provided daily to the adults. As the culture (pupae) was obtained from the castor plant, the leaves of castor were provided as clean food. The fresh leaves brought to the laboratory and were cleaned with the help of sterilized cotton bolls to remove adherent dust particles.

The incubation period was observed along with percentage hatch rate describing the mortality at this stage. Similarly the corresponding duration of larval instars were also recorded with instar specific mortality under laboratory condition. At final instar stage, prior to the pupation, the larvae were separated in a batch of single individual, as this stage was inactive hence no food was provided.

After pupation again the pairing was done on the basis of their size in glass jars. This ensured a pair of male and female for mating and egg laying. After emergence, pre-mating, mating

and post mating period was recorded. After successful mating, the egg laying capacity per female was also computed. Further, life of adults (male and female), after egg laying along with total longevity was also recorded.

Morpho-metrics and weight measurements

For the measurement, the vernier caliper was used and fully fed and dead, larvae and adults were used. The length of larvae was considered from cranium to last abdominal segment. In case of eggs, the hairs were not taken in to account for the measurement. The adult was measured for the wing span using horizontal length of forewings. The weighing was done for eggs and immature developmental stages only.

LIFE CYCLE

The present investigation on life attributes of *Trabala vishnou* under laboratory condition revealed its distinct bi-voltine and holo-metabolous life. The results has been summarized as under.

Incubation Period

Under a given set of environment, the transformation of eggs into larva took 8.80±1.30 days in first generation and 7.20±1.50 days in the second generation (Table, 1). The eggs were found creamish in colour, beautifully threaded with flagellate hairs (Figures,1 and 2). During this stage 40-45% eggs could not produced the progeny and turned darker later on.

Larval Development

There are six distinct instars was recorded. The development did not follow any marked pattern (Figures, 1-5). The first instar lasted for 7.18±1.30 and 6.58±0.85 days in first and second generation, respectively. It was only the third instar which survived for more than 8 days (8.12±0.89 days) in first generation however longest larval duration in second generation was also seen in third instar stage (8.85±0.88 days). The second, third, fourth, fifth and sixth instars duration was recorded as 7.25±0.45, 8.12±0.89, 7.75±0.55, 7.25±0.71 and 7.75±0.55 days, respectively in the first generation and 7.45±0.58, 8.85±0.88, 7.00±1.25, 7.00±1.71 and 8.55±0.86 days in second generation. The highest range of mortality was noted on second instar (50-55%) followed by third instar (40-45%), fourth instar (35-40%), fifth instar (30-35%) and sixth instar (20-25%) in first generation whereas a comparatively low mortality was observed in second generation. When the duration was pooled the total immature development lasted for 44.46±2.71 days showing figures 30-40, 40-50, 40-45, 30-

35, 30-35 and 25-35% for second, third, fourth, fifth and sixth instar stages, respectively (Table 1)

Pupal Development

The larval stages were densely flagellated with fine hairs. The final instar of *T. vishnou* after a week of development started making the hairy sac pupation. They confined itself this way inside so formed sac. Interestingly, after the transformation of this hairy pupal sac, the larvae casted its skin and discarded the same by cutting a circular hole at hanging bottom (**figures, 9 and 10**). The exuviae was found hanging upside down. The pupal period was of a bit longer duration in second generation (16.00±0.83 in I and 18.00±1.25 days in II generation), and was also highest among rest of life stages. The natural mortality was recorded as (20-30% in I and 15-20% in second generation). The sac was of light yellow to creamish in colour, resembling a jute bag, however the pupa was recorded to be of dark brown colour (Table, 1).

Adult Stage

The female adult was found to be comparatively bigger in size as compared to adult male. An assorted variation in colour was also seen in male and female moth. The male moth was light green in colour while the female moth was brownish yellow in colour. At resting condition, the forewings of females jointly produced a "V" shape mark however such demarcation was not seen in case of male moths (Figures, 16-17). The adults are lazy and remain inactive initially, hence feeding them is headache. To feed them initially, 15% sugar solution was given in the form of cotton swab but it did not work. Later on a flower pot containing rose and some grass flowers facilitated with small solution droplets was supplied. This facility has attracted them to feed but seemed to be insufficient. Later on the solution was placed as small drops on the wall of rearing jars led to successful feeding which resulted in capable natality. The survival of adult stage was of longer duration in case of females. The corresponding period was observed as 11.75±0.89 days in first generation and 10.84±0.64 days in second generation while male longevity was of 9.25±1.00 and 8.65±0.68 days in respective generations (Table 1)

Reproductive Parameters

There exist a marginal variation in copulation period in both generations (Table, 2). The male and female moths were observed to mate for 6.00±0.70 hours in first generation and 6.35±0.80 hours in second generation continuously. Interestingly, this behavior of mating was recorded during the dark period only. After a successful mating, an apparent period of

pre egg laying (2.25±1.00 days in I and 2.50±1.00 days in II generation) was seen. However, after laying eggs, the female survived (post egg laying period) for 5.50±0.54 and 6.40±0.54 days in respective generations. The fecundity per female also varied to some extent showing the corresponding figures as 218.75±8.45 eggs in first and 218.75±8.45eggs in second generation during its whole lifespan. After the completion of reproductive parameters, the dead individuals of male and female were counted and sex ratio was calculated as 1:0.6 per population in both generations.

MORPHO-METRICS AND WEIGHT MEASUREMENT

In this experiment, all the life stages were measured for length including adult moths (Figures, 14 - 17). The marked variation was apparent among all stages of *T. vishnou* and the length was recorded to increase with advancement of the age of insect. Among all the life stages, the final instar larva was noted to be longest in size. The size of egg was measured as 0.51±0.001 mm. The completely developed first instar stage was of 4.40±0.54 mm in length and the subsequent second larval stage was measured as 7.60±0.54 mm. The third instar larval stage was recorded three times longer than the second instar stage showing a length as 21.4±0.89 mm. Further, fourth instar stage was 32.60±0.54 mm long in size. The fifth and final instar larvae were measured as 37.40±0.89 mm long caterpillars (Table 3).

The pupal stage was scaled only for its actual body and the sac was not included in study. The total length of puparium was recorded as 22.40± 0.54 mm in size.

The adult males and females also varied in size and the female was recorded to be superior one. The wing span of male moth at stretched condition was noted down as 42.400±0.54 mm in size while the female wing span was measured as 54.00±1.41 mm long.

As far as, the observations on body weight of *T. vishnou* were concerned, the adults were not weighed. The eggs, first and second larval instars were less than 0.001 gm in weight. From third instar stage onwards, the weight was observed to increase with advancement in age. The third, fourth, fifth and sixth instar were weighed as 0.173±0.001, 0.466±0.003, 0.582±0.001 and 1.962±0.001 gm, respectively. In case of pupal stage, once again, only the brownish body was weighed leaving the sac un-weighed and the weight was recorded as 0.538±0.042 gm (Table 3).

Table 1: Immature life of *Trabala vishnou* fed on castor (29±2˚C; 16L:8D)

(Generation I)			(Generation II)		
Stages	**Duration**	**Mortality %age**	**Stages**	**Duration**	**Mortality %age**
Egg	8.80±1.30	45-50	Egg	7.20±1.50	40-45
Ist Instar	7.18±1.30	40-50	Ist Instar	6.58±0.85	30-40
IInd Instar	7.25±0.45	50-55	IInd Instar	7.45±0.58	40-50
IIIrd Instar	8.12±0.89	40-45	IIIrd Instar	8.85±0.88	40-45
IVth Instar	7.75±0.55	35-40	IVth Instar	7.00±1.25	30-35
Vth Instar	7.25±0.71	30-35	Vth Instar	7.00±1.71	30-35
VIth Instar	7.75±0.55	20-25	VIth Instar	8.55±0.86	25-35
Total	54.46±2.71	_	**Total**	52.63±2.46	_
Pupal Period	16.00±0.83	20-30	Pupal Period	18.00±1.25	15-20
Adult Male	9.25±1.00	_	Adult Male	8.65±0.68	_
Adult Female	11.75±0.89	_	Adult Female	10.84±0.64	_

Table 2: Reproductive parameters of *Trabala vishnou* on castor (29±2˚C; 16L: 8D)

(Generation I)		(Generation II)	
Reproductive Parameters	**Units/female**	**Reproductive Parameters**	**Units/female**
Mating duration	6.00±0.70 days	Mating duration	6.35±0.80 days
Pre egg laying period	2.25±1.00 days	Pre egg laying period	2.50±1.00 days
Post egg laying period	5.50±0.54 days	Post egg laying period	6.40±0.54 days
Number of eggs/ Female	247.75±10.33 eggs	Number of eggs/ Female	218.75±8.45eggs
Sex ratio	01:0.6	Sex ratio	01:0.6

Table 3: Morphometrical and weight measurements of *Trabala vishnou* fed on castor

Stages	Length	Weight
Egg	0.5124±0.001	<0.001
Ist Instar	4.400±0.548	<0.002
IInd Instar	7.600±0.548	<0.021
IIIrd Instar	21.400±0.894	0.173±0.001
IVth Instar	32.600±0.548	0.466±0.003
Vth Instar	37.400±0.894	0.582±0.001
VIth Instar	47.200±0.837	1.962±0.001
Pupa	22.600±0.548	0.538±0.042
Adult Male	42.400±0.548	_
Adult Female	54.000±1.414	_

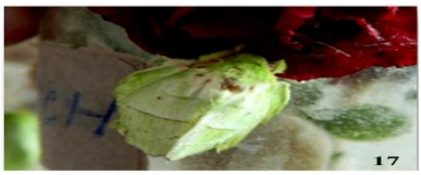
Figures (1-8) *T. Vishnou* - Eggs (1 & 2); Larval Instars (3-8), 3. I instar; 4. II instar; 5. III instar; 6. IV instar; 7. V instar; 8. VI instar.


Figures (9-10): Pupal stage of *T. vishnou* with peculiarities



Figures (11 – 13): Pupal stage of *T. vishnou*



Figures (14 – 17) Adults of *T. vishnou*: 14 & 15, adult females; and 16 & 17 adult males.

DISCUSSION

The present investigation on life attributes of *Trabala vishnou* under laboratory condition revealed a distinct bi-voltine and holo-metabolous life. The generations varied in their development particularly of larval instars (Singh *et al*., 1990). Under a given set of environment, the transformation of six larval instars were observed feeding voraciously on castor leaves. However, they show variation in the duration of their developmental stages. Among all the life stages of *T. vishnou*, the third larval instar took maximum time for its development. After completion of immature development, the final instar transformed into pupa and this pupa metamorphosed into an adult. The reproduction was recorded as sexual and the eggs were laid in linear fashion on rearing medium. The final instar of *T. visnou* after a week of development, started making the hairy sac pupation. They confined itself this way

inside so formed sac. Interestingly, after the transformation of this hairy pupal sac, the larvae casted its skin and discarded the same by cutting a circular hole at hanging bottom. The exuviae was found hanging upside down. These findings are being observed at very first time for this lappet moth (*T. vishnou*). The sac was light yellow to creamish in colour, resembling a jute bag, however the pupa was recorded to be of dark brown colour. The female adult was found to be comparatively bigger in size than male. An assorted variation in colour was also seen in male and female moth. The male moth was light green in colour while the female moth showed a yellowish pattern of body colour. At resting condition, the forewings of females jointly produced a "V" shape mark, however, such demarcation was not seen in case of male moths. As far as the mortality during the development was concerned, second and third instar larva exhibited highest susceptibility. Similar findings on biological attributes of *T. vishnou* were also reported by Singh *et al*., (1990), however, in his findings only five larval instars were recorded offering a contradiction with present studies. Tewari and Namgail (1999) has also made an effort to study the biology of *Trabala* species on different hosts but the results on castor are showing corroboration with these findings.

The observations showed a distinct variation in morphometrical measurements on the basis of age of *T. vishnou*. Taxonomists have frequently used phenotypic variations as primary parameters in separating many natural populations of organisms and many species have been described based on the results of these studies (Mehrparvar *et al*., 2012). Every larval instar was complimentary to each other in appearance; it was the size only that differentiated them after moulting took place. The present investigation on body weight is in agreement with Kirichenko *et al*., (2011). The measurements of body length and weight of *T. vishnou* reared under laboratory condition were found to be instar specific and their size increased with the advancement of age. There was generally a little overlap between successive instar and it was evidently easy to separate different larval instars accurately on the basis of these measurements. These phenotypic revelations under present investigation can be used to differentiate inter as well as intra specific populations of *T. vishnou*.

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